

AMENDMENTS TO THE CLAIMS

Please cancel claims 1-56, 61, 65, 71, 75 and 77-88 without prejudice or disclaimer to further prosecute their subject matter, amend claims 57, 62-64, 66, 67, 72-74 and 76, and add new claims 89-104 as follows.

1-56. (Cancelled).

57. (Currently Amended) A method for canceling multiple user interference in a communications system wherein a plurality of users communicate over a shared channel, the method comprising:

receiving ~~a set of~~ data that provides a plurality of discrete values produced at a sub-symbol interval that is less than a full symbol period; ~~and~~
~~estimating bits for a symbol corresponding to a given user by~~ interpolating the signature waveforms for at least some of the plurality of users to a common sampling lattice of the received ~~set of~~ data; ~~and~~
iteratively calculating a symbol estimate corresponding to a given user at the sub-symbol interval using the interpolated signature waveforms, wherein iterations of calculating the symbol estimate respectively comprise:
determining a current interference estimate for a current sub-symbol interval by combining the determined interference contributions for individual ones of the plurality of users corresponding to a previous sub-symbol interval,
removing the current interference estimate from the received data to provide an innovation signal for the current sub-symbol interval, and
in parallel, adding the innovation signal for the current sub-symbol interval to the interference contribution from a given user to produce an interference

cancelled signal for the given user, using the interference cancelled signal for the given user for the current sub-symbol interval to update the symbol estimate for the given user at the current sub-symbol interval, and determining an interference contribution for individual ones of the plurality of users for use in determining a next interference estimate for a next sub-symbol interval.

58. (Original) The method of claim 57, wherein the communications system is a code division multiplex access communications system.

59. (Original) The method of claim 57, wherein the communications system is an asynchronous code division multiplex access communications system.

60. (Original) The method of claim 57, wherein the sub-symbol interval is a chip interval.

61. (Cancelled)

62. (Currently Amended) The method of claim ~~61~~, 57, wherein the interpolated signature waveforms is are used to ~~perform signal reconstruction for a first sub-symbol interval and is retained to estimate bits in a second sub-symbol interval that follows the first sub-symbol interval~~ update the symbol estimate for the given user at the current sub-symbol interval and determine the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

63. (Currently Amended) The method of claim 62, wherein a sub-symbol delay accommodates concurrently retaining the interpolated signature waveforms for bit updating symbol estimation in the ~~second~~ current sub-symbol interval and for ~~signal reconstruction for the first sub-symbol interval~~ determining the interference contribution for individual ones of the

plurality of users in the next sub-symbol interval.

64. (Currently Amended) The method of claim 57, wherein a plurality of decoupled multi-user detection processing elements respectively determine in parallel the interference contributions for ~~each~~ individual ones of the plurality of users at the sub-symbol interval.

65. (Cancelled)

66. (Currently Amended) The method of claim 57, wherein the symbol estimate is for a multiple bit symbol.

67. (Currently Amended) An apparatus for canceling multiple user interference in a communications system wherein a plurality of users communicate over a shared channel, the apparatus comprising:

an input that receives ~~a set of~~ data that provides a plurality of discrete values produced at a sub-symbol interval that is less than a full symbol period; and

a multi-user detection module that ~~estimates bits for a symbol corresponding to a given user by interpolating~~ interpolates the signature waveforms for at least some of the plurality of users to a common sampling lattice of the received set of data and iteratively calculates a symbol estimate corresponding to a given user at the sub-symbol interval using the interpolated signature waveforms, wherein iterations of calculating the symbol estimate respectively comprise:

determining a current interference estimate for a current sub-symbol interval by combining the determined interference contributions for individual ones of the plurality of users corresponding to a previous sub-symbol interval, removing the current interference estimate from the received data to provide an innovation signal for the current sub-symbol interval, and

in parallel, adding the innovation signal for the current sub-symbol interval to the interference contribution from a given user to produce an interference cancelled signal for the given user, using the interference cancelled signal for the given user for the current sub-symbol interval to update the symbol estimate for the given user at the current sub-symbol interval, and determining an interference contribution for individual ones of the plurality of users for use in determining a next interference estimate for a next sub-symbol interval.

68. (Original) The apparatus of claim 67, wherein the communications system is a code division multiplex access communications system.

69. (Original) The apparatus of claim 67, wherein the communications system is an asynchronous code division multiplex access communications system.

70. (Original) The apparatus of claim 67, wherein the sub-symbol interval is a chip interval.

71. (Cancelled)

72. (Currently Amended) The apparatus of claim 71, wherein the interpolated signature waveforms are is used to perform signal reconstruction for a first sub-symbol interval and is retained to estimate bits in a second sub-symbol interval that follows the first sub-symbol interval update the symbol estimate for the given user at the current sub-symbol interval and determine the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

73. (Currently Amended) The apparatus of claim 72, wherein a sub-symbol delay accommodates concurrently retaining the interpolated signature waveforms for bit updating

symbol estimation in the ~~second~~ current sub-symbol interval and for ~~signal reconstruction for the~~
~~first sub-symbol interval~~ determining the interference contribution for individual ones of the
plurality of users in the next sub-symbol interval.

74. (Original) The apparatus of claim 67, wherein a plurality of decoupled multi-user detection modules respectively determine in parallel the interference contributions for ~~each~~ individual ones of the plurality of users at the sub-symbol interval.

75. (Cancelled)

76. (Currently Amended) The ~~method~~ apparatus of claim 67, wherein the symbol estimate is for a multiple bit symbol.

77-88. (Cancelled).

89. (New) An apparatus for canceling multiple user interference in a communications system wherein a plurality of users communicate over a shared channel, the apparatus comprising:

means for receiving data that provides a plurality of discrete values produced at a sub-symbol interval that is less than a full symbol period;

means for interpolating the signature waveforms for at least some of the plurality of users to a common sampling lattice of the received data; and

means for iteratively calculating a symbol estimate corresponding to a given user at the sub-symbol interval using the interpolated signature waveforms, wherein iterations of calculating the symbol estimate respectively determine a current interference estimate for a current sub-symbol interval by combining the determined interference contributions for individual ones of the plurality of users corresponding to a previous sub-symbol interval, remove the current interference

estimate from the received data to provide an innovation signal for the current sub-symbol interval, and, in parallel, add the innovation signal for the current sub-symbol interval to the interference contribution from a given user to produce an interference cancelled signal for the given user, use the interference cancelled signal for the given user for the current sub-symbol interval to update the symbol estimate for the given user at the current sub-symbol interval, and determine an interference contribution for individual ones of the plurality of users for use in determining a next interference estimate for a next sub-symbol interval.

90. (New) The apparatus of claim 89, wherein the communications system is a code division multiplex access communications system.

91. (New) The apparatus of claim 89, wherein the communications system is an asynchronous code division multiplex access communications system.

92. (New) The apparatus of claim 89, wherein the sub-symbol interval is a chip interval.

93. (New) The apparatus of claim 89, wherein the interpolated signature waveforms are used to update the symbol estimate for the given user at the current sub-symbol interval and determine the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

94. (New) The apparatus of claim 93, wherein a sub-symbol delay accommodates concurrently retaining the interpolated signature waveforms for updating symbol estimation in the current sub-symbol interval and for determining the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

95. (New) The apparatus of claim 89, wherein a plurality of decoupled multi-user

detection processing elements respectively determine in parallel the interference contributions for individual ones of the plurality of users at the sub-symbol interval.

96. (New) The apparatus of claim 89, wherein the symbol estimate is for a multiple bit symbol.

97. (New) A computer program product for canceling multiple user interference in a communications system wherein a plurality of users communicate over a shared channel, the computer program product stored on a computer readable medium and adapted to perform operations comprising:

receiving data that provides a plurality of discrete values produced at a sub-symbol

interval that is less than a full symbol period;

interpolating the signature waveforms for at least some of the plurality of users to a

common sampling lattice of the received data; and

iteratively calculating a symbol estimate corresponding to a given user at the sub-symbol

interval using the interpolated signature waveforms, wherein iterations of

calculating the symbol estimate respectively determine a current interference

estimate for a current sub-symbol interval by combining the determined

interference contributions for individual ones of the plurality of users

corresponding to a previous sub-symbol interval, remove the current interference

estimate from the received data to provide an innovation signal for the current

sub-symbol interval, and, in parallel, add the innovation signal for the current

sub-symbol interval to the interference contribution from a given user to produce

an interference cancelled signal for the given user, use the interference cancelled

signal for the given user for the current sub-symbol interval to update the symbol

estimate for the given user at the current sub-symbol interval, and determine an interference contribution for individual ones of the plurality of users for use in determining a next interference estimate for a next sub-symbol interval.

98. (New) The computer program product of claim 97, wherein the communications system is a code division multiplex access communications system.

99. (New) The computer program product of claim 97, wherein the communications system is an asynchronous code division multiplex access communications system.

100. (New) The computer program product of claim 97, wherein the sub-symbol interval is a chip interval.

101. (New) The computer program product of claim 97, wherein the interpolated signature waveforms are used to update the symbol estimate for the given user at the current sub-symbol interval and determine the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

102. (New) The computer program product of claim 101, wherein a sub-symbol delay accommodates concurrently retaining the interpolated signature waveforms for updating symbol estimation in the current sub-symbol interval and for determining the interference contribution for individual ones of the plurality of users in the next sub-symbol interval.

103. (New) The computer program product of claim 97, wherein a plurality of decoupled multi-user detection processing elements respectively determine in parallel the interference contributions for individual ones of the plurality of users at the sub-symbol interval.

104. (New) The computer program product of claim 97, wherein the symbol estimate is for a multiple bit symbol.